WHAT IS CLAIMED IS:

SUB A1

1. A method for providing three dimensional optical memory storage, comprising:

subjecting a nanocomposite to irradiation, said nanocomposite comprising a matrix of particles of a liquid core resin surrounded by an inner shell resin and an outer shell resin, said outer shell resin forming a continuous phase of the matrix, said particles of liquid core resin containing at least one photosensitive compound and being in an array in said matrix, said continuous phase being substantially free of said photosensitive compound;

said irradiation being selectively focused on individual particles in said array to effect photobleaching of said individual particles, said irradiation being two-photon irradiation of a wavelength to effect said photobleaching.

2. The method of Claim 1, in which the irradiation is a single beam of irradiation selectively focused on individual particles.

3. The method of Claim 2, in which the two-photon-induced photobleaching causes each particle to perform as an individual bit.

4. The method of Claim 3, in which particles adjacent to the selected particle in the direction of irradiation are photobleached by less than 25%.

5. The method of Claim 2, in which the selected particle is photobleached by more than 50%.

6. The method of Claim 2, wherein the particles of the nanocomposite have an average diameter from about 100 to about 3,000 nanometers and a polydispersity of about 1.00 to about 1.10.

7. The method of Claim 1, wherein both the liquid core resin and the inner shell resin are comprised of copolymers of poly(methyl methacrylate) and poly(butyl acrylate).

8. The method of Claim 7, wherein the copolymers further contain ethylene glycol dimethacrylate as a comonomer.

9. The method of Claim 2, wherein the particles are present in a concentration of from about 10^{11} to about 10^{16} particles per cubic centimeter.

10. The method of Claim 2, wherein the photosensitive compound is present in an amount of from about 0.015 to about 0.5 molar percent based on the total weight of the liquid core resin.

11. The method of Claim 2, wherein the photosensitive compound is selected from the group consisting of photochromic, fluorescent, phosphorescent and mixtures thereof.

12. The method of Claim 2, wherein the photosensitive compound is 4-amino-7-nitrobenzo-2-oxa-1,3-diazol.

13. The method of Claim 1, wherein the liquid core resin has a low glass transition temperature and the inner shell resin is synthesized from a rigid polymer.

14. The method of Claim 1, wherein a relationship between glass transition temperatures of the liquid core resin, the inner shell resin and the outer shell resin is (liquid core resin T_g) < room temperature; (inner shell resin T_g) > (outer shell resin T_g) > (liquid core resin T_g); and (outer shell resin T_g) > room temperature.

15. A nanocomposite comprising a matrix of particles for three dimensional optical memory storage, the particles comprising a liquid core resin containing at least one photosensitive compound; an inner shell resin encapsulating the liquid core; and an outer shell resin encapsulating the core resin and the inner shell resin; and wherein the outer shell resin forms a continuous phase of the matrix.

16. A nanocomposite of Claim 15, wherein a glass transition temperature of the liquid core resin is less than a glass transition temperature of the inner shell resin and the outer shell resin.

17. The nanocomposite of Claim 15, wherein a glass transition temperature of the outer shell resin is less than a glass transition temperature of the inner shell resin.

18. The nanocomposite of Claim 15, wherein a relationship between glass transition temperatures of the liquid core resin, the inner shell resin and the outer shell resin is (liquid core resin T_g) < room temperature; (inner shell resin T_g) > (outer shell resin T_g) > (liquid core resin T_g); and (outer shell resin T_g) > room temperature.

19. The nanocomposite of Claim 15, wherein the liquid core resin and the inner shell resin both comprise polymers derived from at least two same monomers.

20. The nanocomposite of Claim 15, wherein the liquid core resin and the inner shell resin both comprise copolymers of poly(methyl methacrylate) and poly(butyl acrylate).

21. The nanocomposite of Claim 19, wherein a weight ratio of poly(butyl acrylate) to poly(methyl methacrylate) in the inner shell resin is from above about 0.0 to about 0.25.

22. The nanocomposite of Claim 19, wherein a ratio of poly(butyl acrylate) to poly(methyl methacrylate) in the liquid core resin is from about 40 to about 70, mole percentage basis, and the ratio of poly(butyl acrylate) to poly(methyl methacrylate) in the inner shell resin is from about 5 to about 10, mole percentage basis.

23. The nanocomposite of Claim 20, wherein the copolymers further contain ethylene glycol dimethacrylate as a comonomer.

24. The nanocomposite of Claim 15, wherein the inner shell resin is crosslinked.

25. The nanocomposite of Claim 15, wherein an average diameter of the liquid core is from about 50 nm to about 1 nm.

26. The nanocomposite of Claim 15, wherein an average thickness of the inner shell resin is from about 20 to about 60 nm.

27. The nanocomposite of Claim 15, wherein a weight ratio of the inner shell resin to the liquid core resin ranges from above about 0.0 to about 2.0.

28. The nanocomposite of Claim 15, wherein the particles of the nanocomposite have an average diameter from about 100 to about 3,000 nanometers and a polydispersity of about 1.00 to about 1.10.

29. The nanocomposite of Claim 15, wherein the particles are present in a concentration of from about 10^{11} to about 10^{16} particles per cubic centimeter.

30. The nanocomposite of Claim 15, wherein the liquid core resin further contains a photosensitive compound.

31. The nanocomposite of Claim 30, wherein the photosensitive compound is present in an amount of from about 0.015 to about 0.5 molar percent based on a total weight of the liquid core resin.

32. The nanocomposite of Claim 30, wherein the photosensitive compound is selected from the group consisting of photochromic, fluorescent, phosphorescent and mixtures thereof.

33. The nanocomposite of Claim 30, wherein the photosensitive compound is 4-amino-7-nitrobenzo-2-oxa-1,3-diazol.

34. The nanocomposite of Claim 15, wherein the core has a glass transition temperature of from about -50°C to about 15°C; wherein the inner shell resin has a glass transition temperature of from about 100°C to about 150°C; and wherein the outer shell resin has a glass transition temperature of from about 60°C to 90°C.

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